

Memorandum



Date: May 8, 2018

To: City of Wichita

From: Burns & McDonnell

Subject: Northwest Water Treatment Facility: Electrical Power Supply System

SECTION 1 INTRODUCTION

The City has requested that electrical supply alternatives be evaluated to serve the 120 MGD Northwest Water Treatment Facility (NWWTF). It is anticipated that peak electrical demand for this new facility will be in the 10 to 12 MW (megawatt) range. This is large enough that local power supplier Westar Energy will not be able to serve it from their existing electrical distribution system. The City has engaged in discussions with Westar Energy to evaluate options for supplying adequate power with adequate levels of redundancy to the NWWTF. Initial options outlined by Westar involve the construction of a new electrical substation and electrical distribution line(s).

It should be noted that regardless of the selected option below, the NWWTF will include an on-site backup power generation facility capable of powering the NWWTF at peak load. Given the critical nature of this facility, the City recognizes the need for reliable power to provide uninterrupted service to their customers.

This technical memorandum provides a summary of alternative electrical supply options, pros and cons of each option and final selected option.

SECTION 2 ELECTRICAL SUPPLY ALTERNATIVES

There are several options available to serve electrical power to the new NWWTF. All involve the construction of a new substation built adjacent to the Hoover-Evans 138kV transmission line which goes through Sedgwick County Park in a north-south direction ¼ mile east of Ridge Road and parallel to it.

Several options were discussed and broken down to three alternatives. These options are outlined below. The routing of the distribution line(s) for all three options will either be east along 21st or east along 13th street. Either routing will be equivalent in terms of function. The location of the substation will be somewhere adjacent to the 138kV transmission line approximately bounded by 13th St to the South and 21st St to the north.

The options discussed below differ in several main areas:

- Single transformer vs. dual redundant transformers

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- Circuit breakers vs. switchers
- Overhead vs. below grade power

2.1 Substation with Two Transformers, 138kV Circuit Breakers, 2 Underground 12kV Circuits

This option involves the construction of a substation with two 138kV–12.47kV transformers sized and arranged such that if one fails, the other would have sufficient capacity to serve the entire facility. In addition, there would be three 138kV circuit breakers in the substation with protective relaying arranged such that for a fault on any section of the Evans-Hoover 138kV line, only that portion where the fault occurred would be automatically taken out of service. In that scenario, at least one transformer would remain energized which could supply electricity to the entire facility. Two redundant underground 12.47kV circuits would be constructed from the new substation to the NWWTF, each capable of supplying the entire load.

Initial review of this option outlined both benefits and challenges. The key points can be summarized as follows:

- Probability of power loss is very low
- Underground power is more reliable than overhead
- Highest cost

2.2 Substation with Two Transformers, 138 kV Switchers, Two Overhead 12kV Circuits

This option involves the construction of a substation with two 138kV–12.47kV transformers sized and arranged such that if one fails, the other would have sufficient capacity to serve the entire facility. In addition, there would be three 138kV circuit switchers (not circuit breakers as in the earlier option). In this option, for a fault on any section of the Evans-Hoover 138kV line, the entire line would be automatically taken out of service, resulting in a complete loss of utility-supplied electricity to the facility. Power to the unfaulted section of the line could be restored remotely by Westar under most conditions within fifteen to thirty minutes, allowing power to be restored to the facility. Two redundant overhead 12.47kV circuits would be constructed from the new substation to the NWWTF, each capable of supplying the entire load.

Initial review of this option outlined both benefits and challenges. The key points can be summarized as follows:

- 138kV transmission fault results in complete loss of utility-supplied power for 10 minutes up to several hours depending on the severity of the outage.
- Overhead circuit is less reliable than underground
- High cost

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2.3 Substation with Single Transformer, 138 kV Switchers, One Overhead 12 kV Circuit

This option involves the construction of a substation with a single 138kV–12.47kV transformer sized to serve the entire facility. In addition, there would be three 138kV circuit switchers (not circuit breakers as in the first options). In this option, for a fault on any section of the Evans-Hoover 138kV line, the entire line would be automatically taken out of service, resulting in a complete loss of utility-supplied electricity to the facility. Power to the unfaulted section of the line could be restored remotely by Westar under most conditions within fifteen to thirty minutes, allowing power to be restored to the facility. One overhead 12.47kV circuit would be constructed from the new substation to the facility.

Initial review of this option outlined both benefits and challenges. The key points can be summarized as follows:

- No redundancy in transformers or switchgear
- 138kV transmission fault results in complete loss of power for 10 minutes up to several hours depending on the severity of the outage.
- Overhead circuit is less reliable than underground
- Lowest cost

SECTION 3 SELECTED ALTERNATIVE

After review with the City and Westar, a single transformer substation off site, with 138kV circuit switchers and one overhead 12kV circuit was selected as the most cost-effective approach to serve electrical power to the new NWWTF. A value-based decision was made that adequate redundancy is achieved with this option when combined with the on-site power generation facility.